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Science and Art Gossip.

THE Astronomer-Royal for Scotland considers that the comet which has recently been observed near the sun is no other than our friend the Menacing Comet, otherwise known as the *Spectator's* Comet, which is to set the sun aglow after a return or two, and so bring about the destruction of the world, if not of the whole solar system. We give his remarks upon the subject in another column.

THE comet seems not only to have been near the sun in the sky, but actually near to him in space. At least its spectrum showed the sodium lines, bright and well-defined; and we know that in the case of Wells's Comet, the only one which has shown these lines, they did not make their appearance until the comet drew near the point of nearest approach to the sun. The discovery that the cometic spectrum changes as a comet approaches perihelion is not only highly significant in itself, but full of promise. After all, the mysteries of comets may not be so inscrutable as it has seemed likely they would prove.

THE sodium lines, writes Thollon, from Nice, seemed displaced towards the red end of the spectrum. This would show that at the moment of observation the comet was receding rapidly from the earth. The *New York Tribune* says it shows the comet was approaching the earth rapidly, but that is a mistake. Displacement towards the red means recession; approach is indicated by displacement towards the violet.

IT was thought a triumph of science when the induction balance was used to determine the place of the bullet in President Garfield's body. The bullet was wrongly "placed"—a mere detail. Science is, however, consoled. The instrument worked all right, we are told, in a paper read before the Montreal meeting of the American Association for the Advancement of Science; only unfortunately, it mistook (or Professor —— mistook?) a bedspring for the bullet! No wonder some European surgeons doubt whether Guiteau really killed the President. Professor Esmarch says that "repeated probing by fingers and instruments, not protected by Lister's method, caused the suppuration which led to the fatal result." The little bills of the American doctors range from £5,000 for Dr. Bliss, the principal physician, to £200 to Dr. Lamb for the autopsy.

REMARKABLE luminous phenomena were seen in the southern skies on the evening of Monday last. There were auroral streamers and a strong auroral glare of a whitish red colour towards the north (about the direction of the magnetic meridian. The lights seen in the southern sky resembled whitish luminous clouds, along a band rising from the horizon about south-east, and passing over to about north-west. The way in which these clouds varied in apparent lustre, sometimes fading almost out of view, and anon seeming to glow with light, was most remarkable.

BY the last San Francisco mail, we learn that Mr. Binnie, of New Zealand, has devised a plan for making gas from fat, air, and water. The machine employed has two retorts, and a constant dropping of gas is maintained from a service pipe, while from another, water trickles, the relative proportion being one drop of fat to four drops of water. The two ingredients are united with air admitted by a valve, and as the three unite, gas is immediately formed and afterwards purified in the usual way. One man can work several machines. The gas produced burns clearly and has no unpleasant smell. Mr. Binnie calculates that in Dunedin, where the method is to be tried, he can save the inhabitants full 8s. per 1,000 cubic feet.

THE Commissioners of the Aberdeen Harbour have begun to lay pipes for "pouring oil on the water," to calm the surface in bad weather. Cheap fish-oil is used, and harbour authorities all over the Kingdom are anxiously hoping for stormy weather, that they may test, as soon as possible, the value of this method of allaying troubled seas.

IT is said in several American papers, usually well informed, that all passenger trains in that country will before long be preceded by pilot-engines, like the queen's train in England. It is not clear how this is to add to the safety of passengers. What is to prevent the pilot-engine itself from causing a smash? *Quis custodes ipsos custodiat?* When Queen Victoria travels, the idea seems to be, Let every one get out of the way, *quam celerrime* (see her instructions to her loving but, it appears, too obtrusive people—"subjects" the law calls them, though it does not tell us the date of their subjection—after the impressive *Mistletoe* case, which none should forget). But though pilot-engines may ensure safety to the train they precede, they are by no means an element of safety in themselves.

GEORGES LECLANCHÉ, the inventor of the justly-celebrated battery bearing his name, died in Paris, on the 14th ult., at the early age of 43. He was educated at the École Centrale des Arts et Manufactures de Paris, which he left in 1860, and entered the Compagnie du Chemin de Fer de l'Est as a chemical engineer. In 1867 he left this post to devote his attention to his invention, which, it is almost needless to say, has met with that universal favour it so justly merits.

UNDERGROUND TEMPERATURE.—The report of the British Association Committee on "Underground Temperature," shows how impossible it is to give a mean rate of increase.

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It states that the result of fourteen years' observation shows that the increase of subterranean temperature varies in its rate of increase downwards, from 1° Fah. per 130 ft. at the Bootle Waterworks, Liverpool, 1,392 ft. deep, to 1° Fah. every 34 ft. at the Slitt Mine, Weardale, Northumberland, 660 ft. deep. A mean increase of temperature per foot is found from these figures to be ·01563, or 1° Fah. in 64 ft.

The British Army Medical Department reports that uniformly black troops suffer much more than white men from the evil influences of tropical climates. For example, in the West Indies, last year, while the mortality among white soldiers was a little more than eight and one half per thousand, the coloured men died at the rate of nineteen per thousand.

In the early stages of typhoid fever, Dr. Guillasse, of the French navy, has administered coffee with marked success. Three tablespoonfuls are given adults every two hours, alternating with one or two teaspoonfuls of claret or Burgundy wine. A beneficial result is immediately apparent. A little lemonade or citrate of magnesia is also administered daily, and after some time quinine is recommended.

An industrious statistician in England has found that out of 139,143 persons of both sexes engaged in literary work of various descriptions, only twelve became lunatics. It is doubtful if any other profession can make an equally favourable showing.

There are nine hundred inmates in the Georgia Insane Asylum, and a physician connected with the institution says four-fifths of them were insane from the effects of liquor drunk by themselves or their parents.

During a violent thunderstorm at Lebanon, Pa., a short time ago, a meteor weighing one pound eleven ounces fell into the centre of the principal street, appearing like a ball of fire as it struck the ground.

Severe Gale and Electric Storm.—A gale of unusual severity visited our coasts on Sunday last, doing an immense amount of damage, especially on the Irish and Scotch coasts. In the Hebrides it is described as having been a perfect hurricane from the south-west. Many ships were torn from their anchors at Stornoway and driven ashore; others are supposed to have been driven to sea, and "a large number of pleasure and small fishing boats have been sunk, driven ashore, or broken to pieces. In places whole fields of unsecured corn have been scattered and destroyed. Early on Monday morning the telegraph wires, more particularly those running S.W. to N.E., were affected by the passage of earth currents, which continued at intervals throughout the day, and reached their greatest strength in the evening, when there was a brilliant display of aurora borealis, one of the most striking features being the "electric clouds." These were at a considerable height, and had a striking resemblance to masses of light *cirrus*, illuminated from behind by the moon. The earth currents ceased to be noticed at about 3.30 a.m. on Tuesday.

There is a kind of dwarf kangaroo in the Staked Plains of North-Western Texas. Its body is about eight inches long; its fore-legs are not more than an inch and a half to two inches in length; while its hind-legs are all of six inches. It has a tail about eight inches long, completely bare, except a tuft of long hairs at the end and a ridge of short hairs on its upper part. It is also a marsupial, the pouch being well developed. It is of a soft blue colour. Its only mode of locomotion is by jumping, precisely like the kangaroo. It can jump eight or ten feet.

The Sutro Tunnel, now completed, discharges 3,000,000 gallons of hot water daily from the Comstock mines. This water has a temperature of 195°, and is conveyed through a closed pipe-flume to prevent the escape of vapour. After a passage of four miles through the first tunnel, it loses suddenly 70° of heat. A second tunnel, 1,100 feet long, and an open waterway a mile and a half long, conduct the water to Carson River. Along its course are hot-water baths and laundries, and a plan is on foot to conduct the hot water through pipes under ground to be made available for purposes of irrigation and for supplying artificial heat to hot-houses.

Coal-Beds.—A correspondent of the *Times*, writing from the Cape, says:—"From the explorations set on foot by the Cape Government, and recently reported upon, it would seem as though the great Stormberg range of mountains contained an indefinite amount of coal. The Stormberg coal-beds have been locally worked for some time past with very poor appliances. A coal-mine, called the Molteno, is about to be opened some sixty miles north of Queenstown, in which the principal seam extends over an area of 200 acres. Though intercalated by beds of shale, it contains about 2½ ft. of workable coal, the section being thus given:—(1) Sandstone roof; (2) coal, 6 in.; (3) grey shale, 5 in.; (4) coal, 10 in.; (5) black slate, 9 in.; (6) bottom coal, 14 in.; (7) shaly sandstone. No. 2 coal is described as soft, but bright, burning easily, with a white ash. No. 4 is a highly bituminous and good house coal. No. 6 is a hard, compact, and excellent steam coal."

Newspaper and magazine criticisms are sometimes striking. In the *Athenæum*, a few weeks ago, we were told that a *sentimental part* like that of Benedict, in "Much Ado about Nothing," would not suit Mr. Irving! This is quite a new light to play-goers and readers of Shakespeare alike. We shall hear next that Mr. Irving should take only heroic parts, such as Dogberry, Launce, and Ague-cheek.

And now we learn from a trustworthy source that Mr. Charles Reade (whose humour is keener, deeper, and truer than Dickens's) has no sense of humour at all.

Which brings Ouida on the scene. This lady, it appears, cannot read most English novels (many English novel-readers cannot read Ouida—positively find her wearisome); but she *can* read Reade a little—at any rate, he is better than the rest, who always seem, to the judicial Ouida, to write either for school-children or for police-sergeants. This lady finds Reade humorous, though occasionally rather grim. But, sitting in judgment on him, *more suo* (a moth criticising an eagle), she finds that he has never attempted to depict the woman of the world. She evidently has not read "Love me Little, Love me Long" (indeed, from her remarks on Julia Dodd, she obviously does not know that Lucy Dodd—the most disagreeable of Reade's women—had already appeared as Lucy Fountain), or she would have found in Mrs. Bazalgette at least an attempt at the portraiture of a woman of the world.

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GEOLOGY OF LLANDUDNO AND RHYL.

By W. Jerome Harrison, F.G.S.

THE arrangement of the rock-masses which form the north-east of Wales is tolerably clear and easy to make out, contrasting strongly with the broken and intricate nature of the strata which lie further west. In this article I shall describe the geological structure of the country lying east and north of a line drawn from the mouth of the Conway to Cerrig-y-Druidion, and thence to Chester. Either Llandudno or Rhyl form convenient centres from which to explore this area, which has Denbigh almost in its centre, and Mold near its eastern boundary.

The Government Geological Map, sheet 79 (in four parts, price 3s. each), includes the greater part of the district, but Llandudno lies in Quarter Sheet 78 N.E. The purchaser of the new edition of Prof. Ramsay's excellent Survey Memoir on the Geology of North Wales (Stanford, 21s.) will, however, find included in that book an extremely clear coloured geological map of the whole of Wales, although, of course, it is on a comparatively small scale (10 miles to an inch).

Surface Features of the District.—Starting from almost any point in the Vale of Conway, say Llanwrst, and walking eastwards, we ascend a long slope, and soon find ourselves on the table-land of Denbigh, a barren and scantily-peopled district, traversed by few travellers, and seamed by many little streams (of which the Elwy is the principal), running eastwards to pour their waters into the Clwyd.

The strata numbered from 1 to 8 constitute the *solid geology* of the district; they have been up-heaved, or tilted-up, on the west, so that they have a general easterly slant or dip; the glacial and alluvial deposits rest irregularly upon the upturned edges of these older rocks. The diagram (fig. 1) represents the *relation* of the strata to one another:—

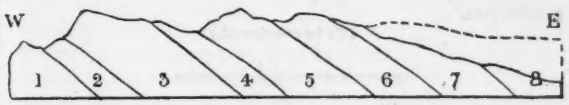

Fig. 1.

Unfortunately, the real position of the rocks is not nearly so simple as that shown in the diagram; the several rock-masses have been so upheaved, broken, and bent by the various movements of the earth's crust which have taken place since their formation, that their actual mode of occurrence is considerably more complex.

Lower Silurian Rocks.—Walking southwards from Llandudno, we come to the low ridge of the Diganwy Hills, formed of a cream-coloured felsite (an ancient lava) of Lower Silurian age; the felsite is overlaid by grey grits and blackish slates seen in several quarries. Tracing these beds southwards by Conway Mountain, they are found to increase greatly in thickness; they are, in fact, the well-known *Caradoc and Bala Beds* which form the entire mass of Snowdon.

Fig. 2.

Crossing a breadth of ten miles of this table-land, we come to the eastern limit, overlooking the fertile Vale of Clwyd, which lies parallel to it. Continuing our easterly walk, the Vale is quickly crossed, but on its eastern side we get a long climb up the highest of the hills (Moel Fammau, 1,823 ft.), whose rounded summits form another north and south ridge; beyond this is a narrow table-land, or rather an elevated shallow valley, bounded on the east by a lower ridge, whose slopes run down to the plain of Cheshire.

Geological Formations.—The country over which our imaginary walk has extended is composed of eight main beds, or layers of hard rock, all resting one upon the other, with an easterly inclination, so that the lowest (and oldest) stratum forms the Vale of Conway, while the highest (and latest-formed) constitutes the plain of Cheshire.

The labours of Sedgwick, Murchison, and the officers of the Geological Survey have proved these beds to follow one another in the following order:—

Formation.		*Sub-divisions.*	*Thickness in feet.*
Recent		Alluvium	0 to 50
Pleistocene		Glacial Drift	0 to 100
Trias	8.	Bunter Sandstone	500
Carboniferous Formation	7.	Coal-measures	1,500
	6.	Millstone Grit	750
	5.	Carboniferous Limestone	1,000
Upper Silurian	4.	Wenlock Shale	2,500
	3.	Denbighshire Grits	1,500
	2.	Tarannon Shale	500
Lower Silurian	1.	Caradoc or Bala Beds	1,000?

Upper Silurian Rocks.—To examine the strata next in succession—*the Tarannon Shales*—we must cross over to the town of Conway; from Conway due south to Llanbedr, a distance of about five miles, we shall find a band of fine smooth grey or blue slates, 500 feet thick, lying *between* the Bala Beds and the Denbighshire Grits; but no such smooth slates are to be found between Diganwy and the Llandudno Junction Station; in this area the gritty strata lie directly upon the Bala Beds. This local absence of the Tarannon Shale is due to an *overlap*; the Bala Beds formed a sea-bottom on which the Tarannon Shales were laid down; a rapid subsidence of this sea-floor led to an irregular recession of its coast-line, so that the succeeding sandy deposit, the Denbighshire Grits, overlapped, or extended beyond the margin of the earlier mud, which, consolidated and compressed, now forms the Tarannon Shales (fig. 2).

This diagram also shows the great *unconformability*, or want of parallelism, between the Lower and the Upper Silurian rocks; a fact which points to a great interval of *time* having elapsed between the formation of the two sets of strata.

To examine the *Denbighshire Grits* we must walk along the eastern slopes of the Vale of Conway; except as a local development of sandy grits with interstratified shale, these beds are not interesting, for their fossils are few and hard to find. The same is the case with the overlying *Wenlock Shales*, which, with the Grits, help to form the wide and barren plateau that lies between the Conway and the

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Clwyd. On the western half of this plateau, the Silurians dip to the east, but they rise again as we follow them eastwards, thus forming a synclinal curve; still further east, they pass *under* the Vale of Clwyd, on the eastern side of which the Wenlock Shales are found with a *westerly* dip, forming the range that includes Moel Fammau; along this eastern range they are well exposed at Cwm and many other points, as bluish-grey unfossiliferous coarse slates or mudstones.

(To be continued.)

ENGLISH SEASIDE HEALTH-RESORTS.

By Alfred Haviland, M.R.C.S., F.R.M.C.S. Lond.

CLASSIFICATION.—LAND AND SEA WINDS.

(Continued from page 212.)

EAST. From the east coast, within zone I.,* we look straight across to Denmark, as we have said, with its two stations, Tarm and Copenhagen. The peninsular and northern part of Denmark separates the Cattegat from the North Sea. This zone includes Berwick (1) and Tynemouth (2).

From Hartlepool (3), Redcar (4), Saltburn (5), Whitby (6), Scarborough (7), Filey (8), and Bridlington (9), within zone II., the observer when looking east is opposite the North Frisian Islands, Sylt Point, Vesterland, the Isle of Heligoland, and the mouth of the Eider.

The coast within zone III., including Spurn Point and Great Grimsby (11), is opposite Hanover and the mouth of the Elbe.

Cromer (14), Great Yarmouth (15), Lowestoft (16), Aldborough (17), within zone IV., look towards the East Frisian Islands, Terschelling, Vlieland, and Texel, which form a part of the Netherlands, and enclose the channel leading to the Zuyder Zee, on which Amsterdam, at about 52° 22′ Lat. N., stands.

From the coast within zone V., on which we find Southend (18), Sheerness, Herne Bay (19), Margate (20), Ramsgate (21), and Deal (22). The observer, on looking due east, would have opposite to him the mouths of the Maas; at about 51° 38′, Lat. N., the East Scheldt River; and at 51° 32′, Walcheren Island, where in 1809 the marsh fever decimated the English army, under the incapable Commander-in-Chief, Lord Chatham, the elder brother of William Pitt, who managed to get 7,000 of his men killed by this disease, and half of the remainder permanently disabled. Walcheren Island is opposite the mouth of the Thames.

We have now seen that that part of the east coast which extends from Berwick to the mouth of the Humber looks towards Denmark, which peninsula—averaging 85 miles across—separates the North Sea from the Cattegat and the Baltic Sea; so that winds proceeding straight from these easterly points have considerable marine characters. From the mouth of the Humber, however, southwards to the South Foreland, our coast faces the western end of a belt of continent unbroken by a single sea inlet from the west coast of Europe to the east of Asia; so that one could walk on dry land eastward within this belt from the west coast of Europe to the western shore of the Gulf of Tartary, in the Okhotsh Sea, 141° long. E., passing through Holland, Germany, Poland, Russia, the Steppes of the Kirghiz, and Asiatic Russia; but the Europe-Asian continent contains a still longer belt to the the one just mentioned.

* See "Climate Chart," p. 163.

We have called attention to these geographical facts, not that we believe that any wind that reaches our shores has ever passed along this belt in its entire length, but to show how impossible it is for any wind that comes to us for any length of time from a remote part of the Continent to be otherwise than deprived of any marine character it might have set out with. We are speaking now of those east winds that blow to us from the Continent, week after week, at some periods of the year, especially during the spring months; and which have such a baneful effect on the consumptive and those subject to rheumatism and neuralgia. We do not include in the category of east winds those which come to us from off the sea in the course of their circuits around some local area of low barometric pressure; nor the morning *sea breezes* on the east coast, which are caused by the sun-heated surface of the land causing the air above it to ascend, and the cooler air over the sea to take its place. After sunset, the earth rapidly radiates its heat, and cools down to a lower temperature than the sea, over which the warmer air ascends, and, as it were, makes way for the cooler air of the land which flows towards it, causing the evening *land* breeze. On the west coast, of course, the morning *sea* breeze would be westerly and the evening *land* breeze easterly. Simple as the phenomena of the *land* and *sea* breezes are, they contain the elements which bring about the circulation of the whole atmosphere of the globe; and when once mastered and studied in connection with the earth's rotation, will considerably help the student to understand the causes of the winds and their influence on oceanic currents.

The east wind as we get it in England is characterised by great dryness; in fact, it is the driest of our winds, and is in direct contrast to our south-west wind, which is the most moist. Mr. Alexander Buchan, in his papers on the prevailing winds of the world, has shown why these winds prevail in Great Britain in spring. He says that they are always dry; but in some years, as in May, 1866, they reach an almost unprecedented dryness, such low humidities as 44 and 37 (saturation point being 100) having been observed at many places in Scotland at nine a.m. As to their cause, he remarks that the Isobaric charts for the spring months exhibit a smaller difference of mean pressure between Great Britain and the north of Europe than during the other months. This smaller difference arises from the more frequent occurrence during these months of *higher* pressures to the north and north-east, or *lower* pressures to the south and south-east of Great Britain than in Great Britain itself; and it is from the repeated occurrence of these throughout the year, that next to S.W. or W.S.W., easterly winds are the most prevalent. Sometimes, and in some years—notably during 1867—high pressures prevail to the north-west of Great Britain, in which case the cold current comes to us a north, north-west, or even west wind. But it matters not from what direction, or in what guise, the cold, dry current comes to us, its noxious characteristics are the same, and it is *nearly* as injurious to health and vegetation as the "horrid east."

It must be remembered that mere *dryness* would not cause all the evil that is laid to the charge of the east wind. So far as this character, is concerned, it is just possible that, under the circumstances named by Mr. Buchan, the winds he names would be dry and exhaust all the moisture possible from trees and plants, and it is possible also that their keenness and dryness combined would materially affect the public health in the manner generally attributed to east winds, but the winds named are essentially sea winds, and never lose their marine character entirely, for, although they may be deprived of much of their moisture, they

remain still ozoniferous, and never can become entitled to the term *effete*, as the wind that comes to us from the Continent always is.

After floating over the Continent for days, and perchance weeks, such a vast volume of air as blows over the narrow sea between England and the Continent could scarcely acquire in the short space of time occupied by its passage a true marine character; and evidence of this is seen in its great *dryness* and the deficiency in what has been termed ozone. For many years we took observations at all hours and in a variety of localities, both inland and coastal, and we invariably found that the east wind was defective in, if not entirely free from, ozone.

This want of the vivifying element of pure air, combined with a want of moisture, we believe to be the cause of the obnoxiousness of the east wind to all, and especially to those who are delicate. We shall show, in a future paper, how fatal it is in those parts of England that are not protected from its malign influence.

OF AN OBSERVATION NOT LONG SINCE MADE IN ENGLAND OF SATURN.

THIS Observation was made by Mr. William Ball, accompanied by his brother, Dr. Ball, October 13, 1665, at six of the Clock, at Mainhead, near Exeter, in Devonshire, with a very good Telescope near 38 foot long, and a double Eye-glass, as the observer himself takes notice, adding that he never saw that Planet more distinct. The observation is represented by Figure 3, concerning which the Author saith, in his letter to a friend, as follows :—"This appear'd to me the present figure of Saturn, somewhat otherwise than I expected, thinking it would have been decreasing; but I found it full as ever, and a little hollow above and below. Whereupon the Person, to whom notice was sent hereof, examining this shape, hath by Letters desired the worthy Author of the *Systeme of this Planet* that he would now attentively consider the present Figure of his *Anses* or *Ring*, to see whether the appearance be to him as in this Figure, and consequently whether he there meets with nothing that may make him think that it is not *one* body of a Circular Figure that embraces his *Diske*, but *two*."

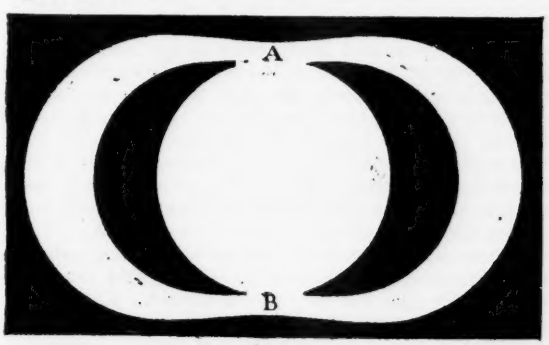

Fig. 3.

And to the end that other Curious men in other places might be engaged to joyn their Observations with him, to see whether they can find the like appearance to that represented here, especially such Notches or Hollownesses, as at A and B, it was thought fit to insert here the newly-related Account.—*Philosophical Transactions*, Vol. I. for 1665 and 1666, p. 152-3. (The engraving faces p. 155.)

THE RAIN-BAND.*

By C. Piazzi Smyth, Astronomer Royal for Scotland.

(*Continued from page* 294.)

BUT if so much can be done by so small a spectroscope, the question may be well asked whether more still might not be accomplished with a bigger and more powerful one, especially seeing that the dispersive powers of both chemical and astronomical spectroscopes have in late years been increased to a most astonishing extent. The question is important, and somewhat new as well. I propose, therefore, to devote the remainder of my space to its answer, rather than to the practical rules for using the smaller instruments, especially, too, as they have been already introduced to the public, both by my friend, Mr. Rand Capron, in his pamphlet, "A Plea for the Rain-band," and by myself, in the fourteenth volume of the "Edinburgh Astronomical Observations;" also in the Journal of the Scottish Meteorological Society, and in the September number of the Astronomical Register for 1877.

The greater part of higher power spectroscopes are not suitable to rain-band work, for their fields are usually too dark. But having recently built up for myself a large-sized variety of the instrument, possessing perhaps the greatest combination of power with transparency yet attained, and having it always mounted in an upper chamber looking out at an altitude of about 5° over the north-western horizon (or most suitably for rain-band work), I will try to describe shortly its action therein.

The classical "rain-band," which in the little instrument is merely a very narrow fringe to an almost infinitely thin black line, is so magnified laterally in the larger instrument as to fill the whole breadth of the field. The thin black line before spoken of is now not only split into two, but each of these are strong, thick, sharply-defined lines, separated from each other by six or seven times the breadth of either. These are the celebrated Solar D lines, D1 and D2 arising from the sodium metalloid burning or incandescent in the sun. They are, therefore, perfectly uninfluenced by changes of the terrestrial atmosphere, hot or cold, wet or dry, and are, therefore, invaluable as references for degree of visibility of the water-vapour lines and bands which rise or fall in intensity precisely with those changes. There are several of these earthly water-vapour lines and bands in and between and about the D lines themselves; then a long breadth of band towards the red side of D1; then a pair of lines not so widely apart as the D lines, but sometimes just as sharp and black; then two or three fainter bands; then a grand triple, of which the nearer line sometimes attains greater blackness than either D line; then beyond that three distinct, equal-spaced, isolated bands; and further away towards the red a stretch of faint haze and haze-bands.

All these go to make up the one thin rain-band of the little spectroscopes; and I fortunately had, through the month of August and the early days of September, occupied myself each morning in noting the greater or less intensity of each, and all these water-vapour lines and bands in terms of the two Solar constants D1 and D2; and every such morning there was an abundance of details to see, to recognise, and to measure. But on the morning of Monday, September 4, when the little instrument had truly enough marked 0 on its very small scale, I almost started at finding in the large instrument every member of its long rain-band group, unless it were a vanishing trace of one or two of the strongest, utterly gone; while the two D lines were in their accustomed strength, but

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far greater clearness, for now they were all alone in the field, save the ultra thin Solar nickel line between them and one or two others, equally thin and Solar on their blue side. The stages of perceptible shade of water-vapour lines which had thus been swept away, between their this day's invisibility, and their tremendous strength no longer before than the previous Friday, might have been expressed by a scale not divided into three parts only, but into 30; and implied such a very unusual amount of absence of water-vapour, that I not only felt sure of no rain falling either next day, or perhaps for several days after, but that the weather must also be coming on colder as well. Therefore it was that I took the step of instantly writing as I did to a local paper, promising the perplexed farmers dry weather at last, though probably sharp and cold, to get in their crops.

And how was that expectation fulfilled? Various meteorologists in different parts of the country have already declared themselves well satisfied with it. But I would now beg further attention to the little daily register already quoted, showing that from and including that day, Monday, September 4, up to and including the next Saturday, not a drop of rain fell at the Observatory. Between the following Sunday and Monday, a drizzle, but only amounting to 0·04 inch, occurred, and after that there were three more days equally dry with the preceding ones. But on Thursday, the 14th, the rain-band reappeared in both spectroscopes in all its force; rain began to fall the same day, and next day's measure at the Observatory amounted to more than half-an-inch. Wherefore it is to be hoped that the farmers had busied themselves effectively while the dry weather lasted, for the return of these spectral lines of watery vapour showed that their autumn opportunity was then gone by.

LEARNING TO SWIM.

By Natator.

(*Continued from page* 213.)

IN my former papers I considered chiefly the beginner, showing how one who knew absolutely nothing about swimming might make his first attempts with safety, and learn readily the all-important art of keeping his balance, whether on his back, which is very easy, or with his back uppermost in the more usual position, which is more difficult. To swim properly requires somewhat more study and practice.

The great general principle in swimming is that the arms and legs, in all methods of swimming, are to be brought forward with the least, and to be carried, or rather driven, back, with the greatest possible effect. This not only distinguishes good swimming from bad, in any given style, but also distinguishes the different styles from each other. Thus the "breast-stroke" is better than the style called "swimming like a dog," because in the former the whole arm is used in propulsion, while in the latter little more than the hand is used; and again, because in the "breast-stroke" the legs are driven back in a much more effective manner, as will be presently explained. So also, the "side-stroke" is more effective than the "breast-stroke," at least for short distances, because the arm, or rather one arm, is carried forward clear out of the water, or without encountering any water-resistance at all.

But before our learner begins to learn any stroke, let him carefully note the following point, the neglect of which has ruined the style of many promising swimmers:—*The body should remain, as far as possible, at the same level during the whole of each stroke.* Many swimmers act as though at each stroke they were striving to save themselves from a watery grave. They drive the hands downwards as forcibly as they drive them backwards, the result being that the shoulders rise out of the water at each stroke, instead of keeping as much under as possible. A good swimmer will scarcely be seen to rise perceptibly in the water, even as he draws in his breath, for he always inflates his lungs when the body would otherwise be slightly sinking. There are, indeed, some who adopt a slightly different plan: they swim with the mouth under water, except when they want to breathe, when they turn the head round as if to lie with the cheek on the water as on a pillow—a movement which brings the mouth just enough above the water to enable the swimmer to breathe. This is theoretically the proper way to breathe so as to minimise work, for in this way a maximum amount of the body's volume remains all the time under water; but it is better to learn this method of breathing later. It is sufficient at first to bear in mind the general principle that, in swimming, not a particle of strength is to be wasted in up-and-down movements. The strokes should be taken so that they shall drive the body steadily forward without either lifting the body or causing it to sink so as to require raising.

So much premised, let us consider how the "breast-stroke" is to be taken.

The swimmer is supposed to be simply balancing himself in the water when he prepares to try the movements now to be described. Placing the hands together close to the breast, with the wrists touching the collar-bones, or nearly so, the palms downwards, and in horizontal plane with the closed fingers, the swimmer launches his arms forward to their full reach in front of him, still keeping his hands together. While he is doing this, he kicks his legs out backwards to their full extent, and so as to throw the feet as far apart as possible. Of these movements only the latter is propulsive. The former merely brings the arms to the right position for their backward propulsive stroke. But though the legs and feet in being kicked out backwards produce a propulsive effect, especially if the feet are well planted, as it were, against the water during their backward sweep, yet it is not in this motion that the legs do the most effective part of their propelling work. The arms are now to be carried backwards with a powerful sweep, the hands being held in the slightly cup-shaped form already described, and the stroke being taken with just so much downward movement, and no more, as is necessary to counteract the tendency of the head to sink when the support of the hands is removed. While the hands are thus brought towards the hips, the legs are to be brought forcibly together, like the legs of a pair of shears when we close it It is in this movement that the legs produce their greatest propulsive effect, an effect which many who think they know how to swim, entirely lose, simply kicking their legs straight out backwards, and then drawing them up under them for the next stroke. This drawing up of the legs under the abdomen must only be begun when the legs have been forcibly brought together, both perfectly rigid till they are in contact. The closing movement of the legs is completed while the arms are doing their backward stroke. The legs are then drawn up under the stomach, the feet being bent back as when we stand on tiptoe, while the hands are brought to their first position by passing from the hips to the chest, the palm and fingers as it were gliding over the body. Then the movements described are repeated. The arms are thrust forward as before; the legs are kicked out; then, while the legs are brought forcibly together, and afterwards carried forward, the arms take their propulsive stroke back-

wards to the hips. Then the movements are repeated, and so on, till the swimmer is tired, or thinks well to change his stroke.

(*To be continued.*)

THE COMET.

IN a letter to the Editor of the *Scotsman* (dated Sept. 24), Prof. Smyth, Astronomer-Royal for Scotland, writes as follows:—Could there have been anything more heartbreaking to all astronomical souls than the uninterrupted cloud by day and cloud by night of our unfortunate climate ever since the announcement of the brilliant daylight comet of Monday, Sept. 18? Tuesday, Wednesday, Thursday, Friday, Saturday, and thus far Sunday also, and their several nights, have each and all been uniformly, utterly covered in with thick, impenetrable clouds; and yet we ought to confess that one other thing might have occurred even so as to make that cloudy appearance more aggravating, more grievously disappointing still. That one overtopping culmination of misfortune would have been, if the spectroscopic observers of Dunecht and Nice had reported that the bright sodium lines of the comet's nucleus were deflected towards the blue end of the spectrum. For in that case the comet would have been coming up to its perihelion; and its necessarily ecstatic display at that period, under fervid solar illumination, might have been taking place precisely during these ultra-cloudy days of the past week.

But both of the spectroscopists of last Monday—the one in France and the other in Aberdeen—declared that the displacement of the lines was towards the *red*, the meaning of which is that the comet was going rapidly away from us,* that it had already passed its perihelion, and was rushing off into distant, cold space, to cool down its substance, which the incandescent-making heat of a very near sun had just caused to give forth the bright spectral lines noticed by the observers. And, in fact, by the time that our terribly thick and moist clouds do at length clear away from above our heads, the comet may be so far away on its aphelion path from both the illuminating sun and ourselves as to be barely visible.

But what comet was it?

The little that was seen on Monday in Scotland is not enough to give any clue; and no London journals, whether scientific or political, which I have seen up to the end of last week throw any light on the matter. But your paper, sir, I am happy to say, did contain on Saturday a note by cable from America, which, if fully correct, is of most profound import. Indeed, nothing so important to all mankind has occurred before through 1800 years at least of astronomical history;† and there is this prospect of the statement being true, that it is given under the name of Professor Lewis Boss, one of the most able and learned mathematical astronomers of the Union, and we may say now (such has been the rapid progress of astronomy during the last few years in that country) of the *world*. He is said then to have concluded from his observations that the comet of last Monday was the comet of 1880 and 1843. A comet on each of these occasions was recognised to have passed closer to the sun's surface than any other known comet. But why has it come back so soon?

In 1843 it appeared to be moving in an orbit of one hundred and seventy years, and yet it came back in 1880, or in only thirty-seven years! That was startling enough, though only looked on by the world as a case of failure of astronomical prediction. But having gone off in 1880, on an understanding generally come to by the best astronomers in Europe, North America, Rio Janeiro, the Argentine Republic, and Australia—at all which latter places it had been well observed—that it was not to return before thirty-seven years (and other comets, such as Halley's and Encke's keep to their times of revolution round the sun nearly uniformly for centuries), behold this comet has returned now, on the strength of your cablegram from America, in two years!

In which case, who can say whether it may not be back again from space in a few months; and then, not merely to graze close past, but actually fall into, the sun, which is so evidently increasing its hold upon it at every revolution? Wherefore we may be near upon the time for witnessing what effects will be produced when such an event takes place in the solar system, as astronomers have only distantly speculated on, and no mortal eye is known to have ever beheld. But we must be calm, patient, philosophical, judicial; for the calculations involved are excessively tedious and difficult when much accuracy is required. The whole of the observations, too, require to be gathered in from all parts of the world, and extensive comparisons of the varying results of different computers have to be made, examined, and discussed with the greatest severity; for how often are there not two appearances very like each other in the immensity of nature, and yet not the same identical thing?—I am, &c. C. P. S.

[We venture to make a slight remark on the above. It relates merely to a matter of detail. Whatever the comet seen on Sept. 18 may have been, it certainly was not the comet of 1843 or of 1880. Professor Boss may be a very able astronomer: but, if so, he is a very careless man. We fear the same must be said of Professor Smyth. For it may be shown (we shall show it next week) that the comet of 1843 or 1880 *could not, in any part of its orbit, be seen from the earth's place on or about Sept.* 18 *within two degrees of the position in which the comet near the sun was actually seen that day.* Nor was it a matter of calculation or requiring nice study, or "calm, patient, philosophical, judicial investigation," to show this. Any one who has clear ideas of the actual relations of the solar system ought to be able to see in a few moments that *the whole orbit* of the comet of 1843, seen from the place of the earth on Sept. 18, would lie far north of the place in which Thollon saw the new comet on that day.—Ed.]

* It by no means follows that because a comet is receding from the earth it is receding also from the sun. A comet may be approaching the sun rapidly when receding rapidly from the earth. Or it may be passing its perihelion when so receding from us. But as the comet's apparent distance from the sun was increasing at the time, it is more probable that the comet had passed its perihelion. —Ed.

† There is a reference here, we imagine, to the Grand Gallery in the Great Pyramid. Of course, the comet seen near the sun on Sept. 19 indicates the approaching end of the Christian Dispensation. Possibly it may be a return of the star seen by the Wise Men at the time corresponding to the other or northern end of the Grand Gallery.—Ed.

Victoria Hall.—It is sometimes said that London working men are less interested in science than the mill-hands of our northern manufacturing towns. If this is so, it is probably, in part, because their attention has not been adequately directed to it. An experimental course of lectures has been planned by the Committee of the Victoria Hall, Waterloo-road, to be held on Friday evenings, at one penny admission, or sixpence and threepence for seats in the balcony. The first is to be by Mr. W. Lant Carpenter, on "Telegrams, and How they Come," on the 29th inst., followed, on Oct. 6, by one on "The Dog as the Friend of Man," by Mr. Arthur Nicols, F.G.S., and on Oct. 13 by one on "A Telescopic Visit to the Moon," by Mr. Mattieu Williams. If these succeed, it is proposed to extend the course.

XUM

NIGHTS WITH A THREE-INCH TELESCOPE.

By a Fellow of the Royal Astronomical Society.

OWING to the delay which has unavoidably taken place in the publication of this series of papers, the constellation Scorpio, with which we shall begin to-night, now souths in daylight, and from the very small altitude of the chief objects in it, is most indifferently placed for the observer.* The chief object in it, a, or Antares (Map, p. 148) is a double star, but, save under the most exceptional atmospheric circumstances, beyond the power of a three-inch object glass. Nevertheless, on a superlatively fine evening, and with the highest power at his disposal, the student *may* pick up the companion as a minute green speck, or wen, attached horizontally to the left of the blazing red disc of Antares itself. ν Scorpii will be seen at first sight as a wide double star, but a little attention will show that the smaller star is not single. β Scorpii is a pretty and easy pair, the contrast of colouring in its components being very pleasing. It is represented in Fig. 46. Half-way between this and Antares, the cluster

Fig. 46.

β Scorpii.

Fig. 47.

μ^1 Sagittarii.

Fig. 48.

π Aquilæ.

80 Messier may be picked up. In the instrument we are employing, however, it will be seen as a nebulous object, strongly resembling a telescopic comet. σ is a pretty pair, but terribly near the horizon. If the student will draw a line from Antares to η Ophiuchi, and travel 10° along it from a Scorpii, he will come upon 236 of Piazzi's hour XVI., a pretty little pair, which will repay scrutiny. Closely following 36 Ophiuchi lies 31 Scorpii (this ought really to be 38 Ophiuchi)—a pretty severe test for a three-inch telescope at any time, and, at present, beyond its power.

Adjoining Scorpio to the east is Sagittarius, but this need not detain us long, as only two suitable objects are to be found in the Map on p. 214, which we are employing. These are μ 1, a striking triple star represented in Fig. 47; and 22 Messier, a pale nebulous mass half-way between μ and σ Sagittarii. This (like 80 M. described above) is really a cluster, but is irresolvable with the means at our disposal.

Aquila, to the north of Sagittarius, is the next constellation we shall examine. Forming an equilateral triangle with ϵ and ζ Aquila is 11, a severe test for the instrument we are employing. The minute companion 19″ above and to the left of the larger star will require the highest power at the observer's disposal to see it at all. At the right hand extremity of the base of an isosceles triangle, whereof ν Aquilæ forms the other end, and δ Aquilæ the apex, 23 Aquilæ will be found. The comes of this is also a star that is invisible with any power less than 250 or so.

* The first two paragraphs of this paper relate to objects well placed when the paper was written by my friend F.R.A.S.; but now not so. The fault is mine.—R. A. P.

π Aquilæ is a very good test indeed. Fig. 48 shows it as seen at moments of the best definition.

In that pretty little constellation, Delphinus, the only star which need detain us is γ, depicted in Fig. 49. The

Fig. 49.

γ Delphini.

Fig. 50.

Vega.

contrasted colours of the components will at once strike the observer's eye.

And next Lyra will claim our attention, and, as is only natural, we shall begin by directing our telescope to its brilliant leader Vega. Here, again, is a severe test, a fine night and a pretty high power being needed to glimpse the comes at all. In Fig. 50 we give something of the appearance of this object, but it is impossible to reproduce in black and white the vivid blue blaze and the mouldings and twirlings of the diffraction rings which surround the great star. Moreover, the size of the minute comparison is exaggerated, or it could not print at all. Not far off we shall find another most interesting object. We refer to the double-double system ϵ^1 and ϵ^2 Lyræ, shown in Fig. 51.

Fig. 51.

ϵ^1 and ϵ^2 Lyræ.

Fig. 52.

57 M. Lyræ.

Fig. 53.

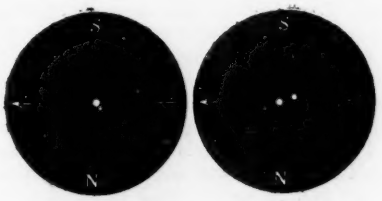
β Cygni.

Between the two pairs lies another minute star, shown in our sketch. There are two others smaller still; they, however, require a larger aperture than ours to see them at all. ζ Lyræ is a wider pair, but pretty from the contrasted colours of its components. Between β and γ Lyræ, but nearer to the former star, will be found that astonishing object, 57 Messier Lyræ, the so-called "Ring-Nebula." Fig. 52 is an attempt to give some idea of its aspect as seen with a power of 70, but wood-engraving does not lend itself well to the delineation of nebulæ. η Lyræ is a widish double, but interesting from the contrasted colours of its components.

We now turn to that glorious region occupied by Cygnus, in which the merest vague sweeping cannot fail to reveal innumerable objects of beauty and interest. We shall, though, select a few of the most striking ones in it for detailed description, as the student can easily wander over the constellation when he has examined them. We will begin, then, with β, the lovely colours of whose components have always rendered it a favourite with the juvenile observer. Fig. 53 gives an idea of the general aspect of this star. $1\frac{1}{4}$° North of χ lies another wide, but beautifully coloured pair, 278 of Piazzi's hour XIX. Nor is χ itself less beautiful and interesting, contrasted colours again forming its chief

charm. ψ Cygni, a close and unequal pair, will require a high power to see it. 2° South-west of ε is 49 Cygni, shown in Fig. 54; while 3° south of ε lies 52, in which the com-

Fig. 54. Fig. 55.



49 Cygni. 61 Cygni.

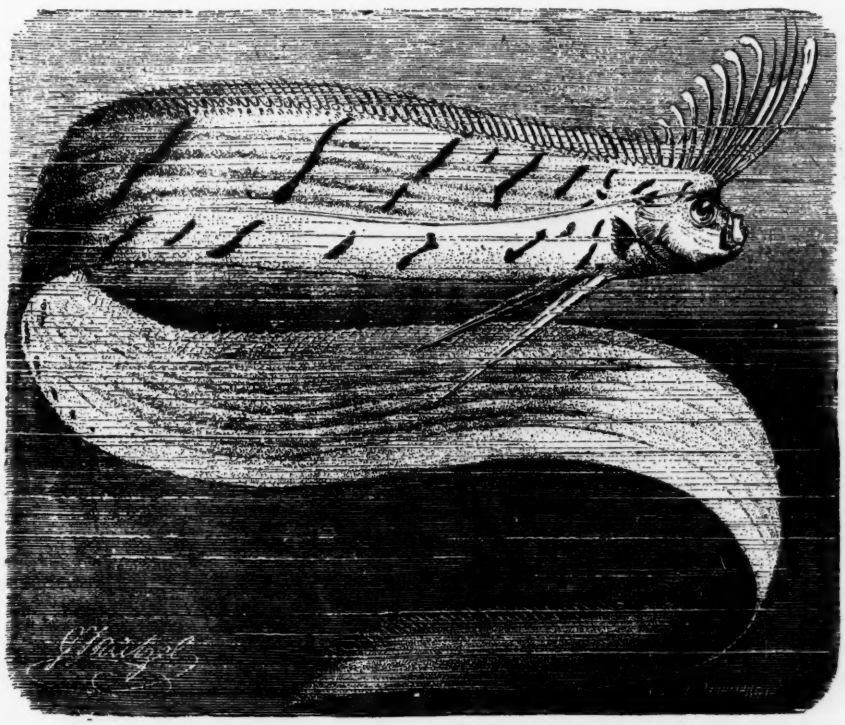
ponents are a little more widely separated. In both cases, as is common in this constellation, the diversity of colours is very beautiful. If we draw an imaginary line from α through ν Cygni, we shall come upon a star (marked, but not numbered, in the Map on p. 214) which must always possess the highest interest for all astronomical students. This is 61 Cygni, the very first of those suns which fill the universe, whose distance from the earth was determined by the illustrious Bessel. We need occupy no further space in a purely practical paper like this, than to say that, so stupendous is the interval separating our solar system from this object, that light (travelling 186,380 miles a second) takes something like six years to pass across it; so that the student whom our description may tempt to look at this interesting object, will see it (not as it is to-night but) as it was six years ago, when the light which enters his telescope left it! 61 Cygni is shown in Fig. 55. Cygnus is so crowded with beautiful fields of stars as to render any selection of them for description difficult; but the beginner may hunt up M. 39 (roughly, half-way between α and ω Cygni) to commence with. μ Cygni is a very pretty triple, the colour of the close pair presenting a pleasing contrast.

(To be continued.)

THE HERRING KING.

THE attention of scientists has frequently been called to the band fishes (*Tœnioidei*), more on account of their odd form than for their value as a food fish. Their body is of an extraordinary length, and is flat, like a band or ribbon, and is covered throughout with small, beautiful, bright and shining scales. The dorsal fin extends over the entire back, and the ventral fin is missing altogether, or consists of a few long, thin, or fragile bone spurs, which are in the front part of the body near the pectoral fins.

Among the band fishes, the herring king, which is found in the northern seas, always creates more or less of a sensation every time one is caught, and that is seldom and far between. As this fish lives in the greatest depths of the ocean, it very rarely occurs that one is washed ashore. It was first discovered on the Norwegian coast in the neighbourhood of Bergen, in 1776, and as the herring were passing along the coast at the time, the new fish was named the Herring King. Later this fish was observed on the Scandinavian and Scotch coast, and lately a specimen was caught at Stavanger, and was preserved in an almost perfect condition. The most striking feature is the exceedingly great length, as most of the specimens caught measured from 9 to 18 feet in length. The head is



THE HERRING KING.

relatively very small, and provided with minute teeth. The bright, silvery, ribbon-shaped body is provided with dark spots and stripes, and the dorsal fin is of a mild pink colour. The first spines or ossicles are of an uncommon length, and form a fan shaped and exceedingly fragile head ornament, which was not found in a perfect condition in any of the specimens.—*Scientific American.*

ANIMAL VACCINE.

DR. DRYSDALE, of London, in a paper read before the Sanitary Congress, said that he had previously recommended that the State, "if it made vaccination obligatory, should give a choice to all to have recourse to animal vaccine instead of humanised. As time passed, however, it began to be ascertained that animal vaccination had far higher recommendation. It was stated by Martin, in 1877, that erysipelas, one of the dangers in arm-to-arm vaccination, was unknown when animal vaccine was used; and latterly, in 1880, it had been given in evidence by Dr. Warlomont, of Brussels, Dr. Martin, of Boston, and Dr. Meares, of San Francisco, that animal vaccination was a perfect preservative against small-pox. Of 80,000 vaccinations made by Dr. Meares, not one was taken with small-pox in the epidemics which attacked so many, and proved fatal to so many of those who were supposed to be protected by having been vaccinated with long-humanised lymph. Dr. Drysdale remarked that he himself had witnessed the great difference in the appearance of the scab when humanised and animal lymph were used. In the former case, the crusts fill before the fifteenth day, and the scar was often extremely slight; in the latter, the crusts often remained on for four weeks, and the scar was like that described by Jenner in his early cases. Humanised lymph was not now nearly so protective as it was at the commencement of the century. Then it was supposed to protect for life. Now, one-tenth of the vaccinated when attacked with small-pox died. He concluded that there was no longer any doubt on this question, and that humanised lymph should be entirely abandoned, as it had been in Belgium, Holland, and the United States, in favour of calf lymph. The State should as soon as possible have stations in the United Kingdom, and dispense gratuitously animal vaccine, as it now does humanised."

Reviews.

AUTUMN LEAVES.*

WE can imagine no more suitable or charming present, at this season, than the beautiful work before us. It has always seemed to us that if an answer is needed to the gloomy question, "Is life worth living?" which some in these days have thought fit to ask, the answer is to be found in the sky and in the woods. Life is always worth living for those who have eyes to see and sense to feel the glory of the clear or cloud-drifted sky, the infinitely varied beauties of woodland scenery. No writer of our day has done more than Mr. Heath to open men's eyes to the grace and charm of forest scenes. Pictorially and poetically, he has brought before us the varied wealth of our woods, our hedgerows, and our pleasant tree-strewn meadows. He has caught, also, with true poetic feeling, that aspect of the woods in which their beauty is combined with the far-off splendour of the sunlit sky. Here, for instance, in the book before us is a passage in which the peculiar loveliness of the blue sky as seen through the foliage of trees is admirably depicted: "Oaks where we stand, growing from either bank, fling their branches from side to side, and meet and interlace midway. But at one spot there is an opening in the leafy shroud, and through the 'vignette' thus woven by the natural and untrained garlands of oak foliage we see the blue sky, and though it is but a patch of uniform colour, and we cannot now see as we could at night the contrasting beauty of the stars—'golden nails'—as a pretty fancy loves to consider them, 'of the floor of heaven'—the sunny blue serves to throw out in strong relief the autumnal colouring of the oak leaves." In this work Mr. Heath describes and pictures the tints of autumn foliage, not only as we see them displayed in great masses in forest scenery, but (with special care) as they are seen in detail. In a former work he has illustrated the leaves of our trees in the summer months. Here he has undertaken the more difficult task of depicting them as they appear when the changes begin to take place on which the exquisite tinting of the trees in autumn depends. He shows us, in fact, the touches by which the great artist Nature produces those charming effects which our painters love to copy, so far as their less masterly touch permits. It is singular, by-the-way, that with Nature teaching them in our woods the beauty of soft tints and gentle contrasts, our British tastes should be chiefly for glaring contrasts and the primary colours, whereas in America, where the woods in autumn actually glow with rich colours and splendid but ever beautiful contrasts, the prevalent national tastes should be in favour of tertiary tints, and associated rather than contrasted colours. In Australia, on the other hand, where the autumn colours are much brighter than in England, the taste for bright and gaudy colouring is more marked even than in this country.

It has been proved that the tissues of plants contain a number of different colouring substances, to which the pleasing name *chromophyll* has been given, to distinguish these colouring matters considered collectively from *chlorophyll*, the substance which, when present in the superficial cells of leaves, causes them to assume, under the action of light, their characteristic green colour. "At night," writes Mr. Heath, "oxygen is largely absorbed by the green parts of leaves. When these are performing healthy functions and are in full vigour, the action of sunlight causes them to part with their oxygen. But as they approach the season for their fall, the active functions of assimilation and exhalation become retarded. The oxygen absorbed at night is not freely given off during the daytime, and its retention in the cellular tissues causes, under the sun's rays, the exquisite tints of autumn. How much," he adds, "these striking effects may be partly dependent upon chemical substances other than oxygen, absorbed into the tissues of plants from their roots, towards the approach of the season for the fall of the leaf, and how much on the action of light upon all these substances, science has not yet been able to accurately determine."

Mr. Heath gives us many specimens in this work of the actual colouring of autumn leaves, the "blossoms of autumn" as they have been poetically called. These pictures show with singular accuracy the outlines of form, the characteristic venation, and the tinting of the leaves. The method by which these beautiful pictures have been obtained is described in the text, though not, perhaps, quite so fully as many readers might wish. There are

* *Autumn Leaves.* By Francis George Heath; with twelve coloured plates. (Sampson Low, Marston, Searle, & Rivington: London.)

eighteen delightful engravings of New Forest scenery, executed from drawings by Mr. Short, who, living amidst the lovely scenery of the forest, "has learned his art from the great book of Nature."

Mr. Heath's work is one which we can thoroughly recommend as well to the lover of nature as to the student of art and science. It is a most enjoyable book. Moreover, it is as handsome in paper, type, and binding as book can well be. Its price (considering the nature of its contents, and, in particular, its twelve charmingly coloured plates, is very moderate.

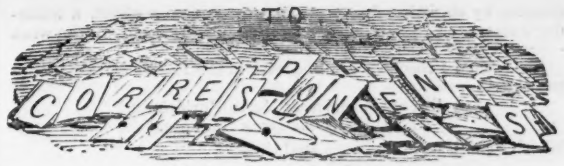
PHOTOGRAPHY AT HOME.*

Of late years there has been a revolution in the art of photography, through which not only has a great change been brought about in the rate at which pictures can be taken, but they can be obtained under much more pleasant conditions. Instead of a dirty, messy, and half-poisonous operation, it has become one which a lady can perform without soiling her fingers. The little book before us shows how the new methods can easily be learned and applied. It gives a brief sketch of the history of photography, describes the wet and dry processes, and gives a number of useful hints about the practical details. The writer points out that the constant study of pictorial effects, the lights and shadows cast by clouds, the changing tints of foliage, and other phenomena of nature, cannot but raise the artistic tone of the mind which practises them. He would even advise parents to let their boys and girls pay some attention to photography, which, if it be only looked upon in the light of a hobby, is at once harmless, healthful, and inexpensive.

THE POLYTECHNIC Y. M. C. INSTITUTE.

LAST Christmas the Polytechnic was purchased by Mr. Quintin-Hogg, and adapted to the purposes of the Young Men's Christian Institute, at the sole expense of Mr. Quintin-Hogg, the cost being more than £25,000. The Institute devotes itself almost entirely to the requirements of apprentices, young mechanics, carpenters, bricklayers, cabinet-makers, engineers, plumbers, and so forth—workshops being prominent features in its system. The portion of the Polytechnic which was formerly occupied by the Small Theatre has been entirely rebuilt, and formed into a fine suite of rooms, which are devoted to the classes in the science, art, and technical schools. Adjoining is a well-fitted and well-furnished chemical laboratory. The Central Hall—the home of the old diving bell—has been converted into a magnificent gymnasium, which is said to be the best in London. The Lecture Hall will accommodate 1,500 persons. There is a fine library and reading-room, with first-class lavatories, fitted with everything a mechanic might require to avoid the necessity of going home before attending the Institute or the classes. The applications for admission are already largely in excess of what had been anticipated. We have looked through the syllabus of the evening classes in science, art, technical and general subjects, with constantly-growing wonder at the wide range and admirable selection of the subjects dealt with.

* *Photography at Home; its Appliances and Apparatus for Amateurs.* (Marion & Co., London.)



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"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

SIZE OF RISING MOON.

[579]—Your late articles on "Forms of Clouds" remind me of a theory I have long since arrived at as to the cause of the magnified appearance of the full moon at or near the horizon. It is briefly this:—There are two skies with which the eye is familiar—the *cloud* sky and the *star* sky, differing remarkably in shape and in the objects they present to observation. The star sky is hemispherical, and may be represented by a semicircle. All objects belonging to it are apparently equidistant from the observer, and each is of the same size, whether seen overhead or near the horizon. Thus, sun, moon, and stars have no appreciable difference of size, and when the atmosphere is clear, but little of distinctness, in whatever part of the sky they are seen. The cloud sky, on the other hand, as shown by your diagrams, may be represented as resembling a small segment of a very large circle. The objects in it are comparatively near when overhead, and very remote when at its extreme parts. Thus a large bird in its flight becomes gradually smaller, and at length is lost in the distance, and, similarly, the largest balloon, though clearly visible when overhead, diminishes as it recedes, and becomes but a point at the horizon, even though, all the while, it may preserve the same vertical distance from the earth's surface. Now if in this cloud sky a second balloon were to be seen near the horizon beyond the clouds and other intervening objects, and having its outline clearly distinguishable and its angular diameter equal to that of the balloon overhead, the observer would instantly feel conscious that such balloon must be enormously larger than the other, and it would scarcely require any further reasoning process to convince him that this must be so.

A precisely similar, though momentary, mental impression is experienced when the clear broad surface of the rising moon looms up behind the clouds and other intervening objects, such as distant houses, trees, ships, &c., seeming, from its apparent proximity and relative position to those objects, to be moving in the same atmosphere which encloses them. Instantaneously the observer's mind refers the great luminous mass to the cloud sky, and, as he suddenly recalls the well-remembered dimensions of the same orb when seen overhead, the comparison, just as in the supposed case of the balloon, flashes on his perception and produces the curious illusion referred to. If the observer now turns his back, and, by means of a small mirror, throws the reflected moon upward into her proper sky, she resumes, at once, her wonted size, and the illusion disappears. G. E.

LOCAL WEATHER LORE.

[580]—In reply to your letter on the above-mentioned subject, I send you three apothegms, &c., &c.,—not, indeed, quite local, but which you may not have heard of. They are:—

First.—"Saturday's Moon comes seven years too soon."

Now, I remember hearing that "saw" from my father one very wild Saturday evening in early summer that we had a walk together. He was a man of limited education, but of considerable sense, dashed, however, with a little superstition, it might be. I, a young lad, in my assumed superior knowledge, ridiculed the notion; but I recollect that many years after, and father had joined the "great majority," taking up an issue of a respectable local newspaper, the *Cork Constitution*, I observed in it a lengthy article,

XUM

showing by statistics, &c., that, however it comes about, a Saturday's moon—*i.e.*, a new moon occurring upon that day of the week —proves itself to be a very unwelcome visitant.

The second I recollect meeting with in the *Family Herald*, and it ran thus:—

"Si sol splendescat Maria Purificante,
Major erit hyems quam fuit ante."

Which distich has been translated thus:—

If Candlemas-Day be cloudy and dark
It will carry cold winter away on its back;
But if Candlemas-Day be dry and clear,
Then half the winter's to come this year.

Well, I declare I think I have observed that adage to be a correct one. [So have I, often: and as often the reverse.—Ed.]

The third, I might say, constitutes my repertory. I should have more, but cannot lay hands on them. The third, then, would be telling you the "Secret of Polichenelli—St. Swithin's. This has been designated superstition too, but here is what is said about him in the "Mirror," vol. II., p. 132:—"There is not any occasion to have recourse to a miracle to account for such a phenomenon. Experience has amply shown that whenever a wet season sets in about the end of June to the middle of July, when the heat of the sun is usually the most intense, it generally continues to nearly the end of summer. When the action of that orb has considerably abated, the rain affording matter for exhalation, always naturally the strongest at the hottest period of the year, and these exhalations yielding in return matter for rain."

So, too, speaks a much higher authority—Howard on "Clouds."

The following excerpt I have taken from Mather's "Drug Circular":—

"WEATHER WISDOM.

"When you wish to know what the weather is to be, go out and select the smallest cloud you see. Keep your eye upon it, and if it decreases and disappears, it shows a state of air which will be sure to be followed by fine weather. But if it increases in size, take your great-coat with you, if you are going from home, for falling weather will not be far off. The reason is this: when the air is becoming charged with electricity, you will see every cloud attracting all lesser ones towards it, until it gathers into a shower; and on the contrary, when the fluid is passing off or diffusing itself, then a large cloud will be seen breaking into pieces and dissolving."

"Evening red and next morning grey, are certain signs of a beautiful day."

"When the glowworm lights her lamp, the air is always damp."

"If the cock crow going to bed, he'll certainly rise with a watery head."

"When the peacock loudly bawls, then we'll soon have rain and squalls."

"When ducks are driving thro' the burn, that night the weather will take a turn."

"If the moon shines with a silver shield, be not afraid to reap your field."

"When rooks fly sporting high in air, it shows that windy storms are near."—*Notes and Queries.*

Hoping that the above contribution may be useful,—I remain, sir, yours, &c., MICHAEL REARDEN.

SINGULAR MENTAL ILLUSION.

[581]—Will you kindly allow me to supplement the terrible ghost story in a recent issue of KNOWLEDGE with some remarks upon an incident which happened to myself, and which comes, perhaps, under the same class of mental illusions, though differing from yours as being of calmer character, and less encumbered by exciting antecedents or by concurrent alarm. The scene was my sleeping-room, and the time about midnight. I do not quite know when, only that it was quite dark. My bed stood in a corner, a wall being close behind it, and another parallel with it, on my right as I lay in bed, at about two and a-half feet distance. One night, while peacefully sleeping, I suddenly woke up to perfect consciousness. The whole corner of the room on my right, near my head, appeared full of light, so bright and clear as to perplex me. I reasoned with myself, "There is no window there, no fire, lamp, candle, or other artificial light of any kind, and yet it's nearly as light as day." Observing more narrowly, I saw a pillow end to end with my own, the curtain of my bed intervening, upon which, and also upon the neatly turned down bed-clothes, I distinctly saw every neat plait and fold. This state of things continued three or four minutes, and then insensibly faded off into darkness. I was not conscious of any agitation or mental disturbance, for the vision rather interested me. I thought it singular, of course, but I fully understood it to be a dyspeptic action of my erratic brain, for my temperament is nervous in the extreme.

I am perfectly sure that no one entered or left the room during the continuance of the phenomenon.

It is clear that the objects I saw might have been of distressing character, in which case I might have produced a story fellow to your own. I am thankful they were no more than passive and tranquil sheets and pillow cases, and light in which to see them.

For the simple truth of my narrative I vouch.

W. H. PERKINS.

THE USE OF DRUNKENNESS.

[582]—Such a vice as this can never burn itself out, or it would have disappeared long ago; it is ever drawing fresh victims into its grasp to supply the places of those whom it destroys. Hence, a nation, such as the North American Indians, which does not possess the moral principles necessary to combat its influence, speedily disappears; and we may rest assured that the hope of England lies entirely in those humanitarian feelings, which have been the mainspring of the Temperance Reformation, now happily beginning to bring about a diminution in the quantity of alcoholic liquors consumed.

Surely Mr. Williams is wrong in assuming that to nearly every drunkard belongs a base and vicious disposition when sober! How many tens of thousands of our countrymen are there of whom it is a proverbial saying that they are the kindest of fathers and the best of husbands until "the drink gets in them?" How many are there in their sober moments who are goaded by the qualms of conscience, and the thought of the misery they are entailing, knowing that in a few hours the despotic thirst will again be all-clamorous, blunting the conscience, until the saturnalia is once more over, when again conscience will speak, it may be, however, in a fainter voice? So much for the process, "enjoyable in their own estimation." If Mr. Williams is sceptical of the reality of this picture, he should give the subject consideration.

Race-development is attained by a nation—as strength by an individual—not by the growth of an unhealthy tendency, which, so far from killing the impure parts, will pollute the lump, but by the elimination, as far as possible, of every taint, and consequently the production of a healthier field for the natural forces to work upon. J. RALPH.

THE NEW USE OF ALCOHOL.

[583]—I cannot help thinking that Mephisto (who gives his experience of alcohol in KNOWLEDGE, Sept. 8) would find a cold bath at night, followed by a few minutes' dumb-bell exercise, as efficient for inducing sleep as alcohol, and preferable to it in its after effects. Would he be so good as to tell us if he has tried it, and if so, with what effects? J. S.

JORDAN-GLYCERINE BAROMETER.

[584]—Will any correspondent kindly give a description of the principle of, and mode of making, the "Jordan-Glycerine Barometer?" C. J. W.

MONKEY AND MIRROR.

[585]—I was in a monkey-house near Manchester, some time ago, when one of the monkeys, having got hold of the cover belonging to a shaving-box, in which was inlaid a small looking-glass, caused very much amusement by holding the glass in one hand, and, whilst looking straight into it, feeling behind it with the other hand for the monkey it thought it saw, which I think was a very intelligent proceeding, and exceedingly practical.

DEO FIDO.

THE "NEW METHOD" OF PRESERVING ORGANIC BODIES.

[586]—The galvanoplastic preservation of organic bodies exhibited by Professor Christian at Berlin, and described in KNOWLEDGE, page 223, is nearly forty years old. I practised it myself in 1845-6. If I remember rightly, it was Parkes, of Birmingham, who invented the process, which was to dip the object in a solution of phosphorus, in bisulphide of carbon, and then into a dilute solution of nitrate of silver. Or the object was first dipped in the silver solution and then exposed to phosphorus vapour. A coating of silver was thereby deposited on its surface.

I improved the original process by diluting the phosphorus solution with turpentine, and adding a little boiled linseed-oil to this. The result was a thin adherent varnish, containing sufficient phosphorus to precipitate the silver as a continuous film. I found that this precipitation was still further assisted by adding ammonia to

the silver solution. Being then engaged in electro-depositing as a business, and these improvements economising the process considerably, I kept them secret for awhile, and sold my phosphorus solution at a good profit, as bisulphide of carbon then cost 2s. per ounce retail, and with one ounce I could make above twenty ounces of the "improved" solution by merely adding the cheap oil and turpentine. I sent a considerable quantity to St. Petersburg.

Practically, however, the method is of very little value. The crab, butterfly, and beetle shown by Prof. Christian may be better preserved by simple drying; and the brain of a rabbit, or other soft putrescent object, only show all their details, as described, when the film of metal is too thin to preserve the object in its original form. If made thicker, it becomes rough and warty, as all who are practically versed in electro depositing well know, and the object is thus defaced.

But for this, works of art in plaster of Paris might be converted into bronzes by simply coating them with copper. I worked at this for some time and made such bronzes, but they were very unsatisfactory. The artistic finish of the original was marred by the coating of metal, just as such things are too often spoiled by successive coats of paint.

The prettiest application is for the silvering or gilding of skeleton leaves, or similar light objects requiring only an immeasurably thin film of metal. This has survived, and is, I believe, still practised.

There is another and far more practical use of the silver precipitation of phosphorus — viz., that of forming a conducting surface on wax moulds and other matrices. I used it largely in conjunction with plumbago, depositing the silver first, and then brushing over with the plumbago. My solution was thus used in St. Petersburg, and may now be useful to some of the readers of KNOWLEDGE. W. MATTIEU WILLIAMS.

DEFECTS OF BICYCLES.

[587]—All riders capable of forming a judgment, and free from prejudice, will agree with your excellent correspondent, Caleb Adams, in the opinion he expresses respecting the defects of the modern bicycle, but what makes his letter of such especial value at the present time is that a determined effort is now being made to import the defects of the modern bicycle into the tricycle. A number of gentlemen, principally racing bicyclists, have been endeavouring for months past to introduce path racing for the tricycle, alleging, as the principal value of such races, the great improvement that will result from proper machines for racing purposes being built by the manufacturers, and thus great alterations being made in the tricycles which have to be ridden on the road. Doubtless the result of this would be much smaller springs, with less elasticity, and, to reduce weight, much smaller steering-wheels. Such alterations would produce little effect that could be felt either on the asphalte track or cinder path, but would be destructive of the good qualities of the tricycle for riding over ordinary roads or touring purposes. JOHN BROWNING.

[588]—I should like to add a few words to the letter of Mr. Caleb Adams (No. 531, page 235). With the general tenor of his experience my own experiments agree, but surely Mr. Adams has overlooked the efforts of the best modern makers to supply a spring which shall be at once neat and efficacious. The "Arab" and Hillman's "gig" spring will readily occur to the practised rider as samples of what I mean.

The small back wheel adds greatly to the appearance of the machine, and its ill effects may be almost entirely counteracted by using a large-size rubber tyre on it. So far as the comfort of the rider goes, the thicker tyre should be on the back wheel, instead of on the front.

As to large saddles, this is entirely within the personal control of every rider. Lamplugh, the great saddle maker, supplies all sizes, from immense tricycle saddles, suitable for sixteen-stone riders, to the smallest racing saddle, and any size is readily affixed to any bicycle. I have this season used a very large size with the best results. H. T. ROUND.

LETTERS IN TYPE.—Physiological Experiment, by Z.; Talking Canary, &c., by Charles L. Cane; Dr. Hunter's Experiments, by Mathilde Van Eys; Coincidences, by A. R. W.; Lapidaries and Deception, by H. M. W.; Figure Training by Corsets, by Alfred Chadwick, M.D.; The Fifteen Puzzle, by A. B.; Flint Jack, by E. T. C. W.; Long Tricycle Ride, by J. F. P.; Spiritualism, by E. P. W.

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Answers to Correspondents.

*** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2 *Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

J. H. W. L. Fancy many would not like portraits. It struck me at the British Association that the insides of scientific heads are, as a rule, better than the outsides.—T. H. Thanks. That subject (the seas) is full of interest. Have dealt with it in the first paper of my "Poetry of Astronomy," "When the Seas were Young," but will try to find room for a paper on the subject in KNOWLEDGE soon.—JAS. PEARSON: Will notice it soon.—W. C. THOMAS, T. H., P. BOSWORTH SMITH, D. R. C. J. CASWELL, A. J., H. J. WATSON, J. W. WILLIAMS, E. H. LEENEY, J. H. W. L., EBEN. JONES, wish the weather chart discontinued.—EX. WY., LIONEL T. WALLER, J. ROUNDHEAD, M. MERES, and others, would prefer some weekly weather record, but are content, if the majority are, that KNOWLEDGE should be without it.—AN OLD SUBSCRIBER tells us that a highly scientific friend approved highly of the Charts—JOHN GREENFIELD thinks that as we still recognise the mark of Balaam's rod on the ass's back, and the impression of Peter's thumb on the haddock (also on the John Dory), so may we find in the earth's tilt a mark of "its having been moved to prevent the sun's setting when Joshua wanted more light to defeat the Amalekites." Science raises its hat to Mr. Greenfield, and bowing, passes on.—C. J. CASWELL. I liked the tables myself; but they were denounced lustily. Fear your friend will hardly enjoy the joke so much as you do.—D. R. Effects of interference too complex, I fear, for discussion here. But two persons not near each other, and both at a considerable relative distance from an orchestra, should hear similar sounds, just as two ships tolerably far from the region where various causes have troubled a sea, are similarly affected, though not near each other. At any given moment, the undulatory conditions are, of course, unlike; but the general effect is the same.—RENDRAG. Will find space for the balloon extract if possible.—G. S. Silent lightning is common when the air is moist; it indicates less electric tension than is present in ordinary thunderstorms. You say it seems to leap from the ground; and in books we often see the statement that lightning is generally seen to pass from the clouds to the earth, though occasionally the other way. But it is demonstrable that no eye can tell which way the lightning travels.—D. DAVIES. An obvious misprint—probably tables stereotyped. Do not know the ballad about half-crown and run-over boy.—H. A. BULLEY. It seems to me, as a layman, that there is much truth in your remarks; but I fear readers of KNOWLEDGE would object to a discussion in these columns of the relative merits of homœopathy and allopathy.—E. D. WAREING. (1) What do you understand by salt water? If you mean simply a solution of common salt in water, the easiest way of distinguishing salt water from sea water would be by tasting. But if you wish to know how sea water may be distinguished from other kinds of salt water, the answer would depend on their nature. In ordinary sea water common salt forms only about two-thirds of the solid matter, of the rest the chief constituents are chloride of magnesium and sulphate of soda (about 5½ parts and 4½ parts, respectively, in a thousand). Carbonate of lime and silica are also present. (2) I do not know how sulphate of iron stains can be removed from white marble. Perhaps some reader can inform us.—E. BRUNETTI. I fear it is hopeless to try to move the M.C.C. to any change.—F. C. S. Your letter about smoking and growth is, unfortunately, too long. I think it is only smoking by young lads which is supposed to interfere with growth. But, for my own part, I look with great distrust on statistics of that sort. On the other subject (alcohol and brainwork), space is a little overcrowded just now. I want that list of letters in type to be shortened quickly.—M. G. OLDHAM. The difficulty is that it is Edward, not Henry, in *Les Mondes*, the Abbé's own paper. A "slip of the pen" would hardly account for such a mistake. Many thanks for your kindly expression of opinion about KNOWLEDGE.—E. R. More astronomy now, since some readers are so pressing. I was so bashful, you perceive.—J. H. W. L. Fear, without the specimens our zoological and geological contributors could hardly decide. The geological question would be especially difficult. Of course, the dental formula, in the other case, is not right for the dog, the likeliest animal otherwise. Are you sure about the molars?—IGNORAMUS No. II. (1) *Do* "objects at a distance look smaller *than they really are?*" If your question means why do objects look

smaller the farther off they are, I fear I can hardly *explain* matters. Why does a pair of compasses open wider the farther you push towards the hinge any object put between its legs? There is no "theory on this subject." (2) "Were my remarks about Cetewayo meant to be sarcastical (Issue of Sept. 1)?" I think I remarked that these coloured and semi-savage kings, all right in their own place, are socially unpleasant and intellectually (in any matter outside fighting), contemptible. I think I further expressed yet greater contempt (or rather disgust) for people who, because these men are called kings, crowd round them, stare at them, bow down to them, and so forth. That was not intended to be either sarcastical or ironical, sarcasm and irony being entirely different from disgust and contempt.—W. G. Woollcombe. (1) I do not know what are the qualities of telescopes by Negretti & Zambra. But you could entirely trust Mr. Browning's own estimate of the second-hand telescope you mention. (2) There is no complete history of the Advance of Science within the last forty or fifty years. (3) Lives of great men are so numerous that it is impossible to select. (4) I do not know of any work in which all recently-invented improvements are described.—J. Hargreave. Surely you must make a mistake. The child cannot have fallen "from the lips of a near relative;" relatives, near or far off, do not carry children in their mouths. I have referred to the *Referee*, and my mind is relieved. "Dagonet" does not say that the child fell that way, though what he says might be so interpreted. What he says is that he had heard the account of the child "which fell out of a moving train, from the lips of a near relative."—A Briton. Why, certainly. The Americans are always shooting each other. You often find it difficult to make yourself heard on Broadway, by reason of the constant firing of revolvers. It is equally true that it is quite unsafe to walk beyond the suburbs of New York, lest an Indian should tomahawk you. Seriously, you should read a little more, and read better books; you would not then believe such foolish stories. I have been, altogether, two years in America, and during all that time I only once heard a pistol fired in anger, and that was fired by a lunatic.—Jas. Nicholson. Book received. Thanks. It shall be reviewed shortly.—M. G. Wells would like to have some information about emigration. But the information he gives about his friend who wishes to emigrate is not very full. This friend has £500, is strong, and intelligent. If that is enough to show where he had better go, perhaps some correspondent will kindly say.—Charles James. The account you give of the meteor is not exact enough to be of use. For instance, what is "the velocity with which a body seems to move from a state of rest?"—A. P. S. Thanks. Will shortly start the monthly astronomical notes you wish for.—R. A. Law. Yes; there were many remarkable meteors in 1783. Gilbert White writes: "The summer of 1783 was an amazing and portentous one, and full of horrible phenomena; for besides the alarming meteors and tremendous thunder-storms that affrighted and distressed the different counties of this kingdom, the peculiar haze or fog that prevailed for many weeks in this island, and in every part of Europe, and even beyond its limits, was a most extraordinary appearance, unlike anything known within the memory of man." This agrees well with Cowper's lines—

> "Fires from beneath, and meteors from above,
> Portentous, unexampled, unexplained,
> Have kindled beacons in the skies."

—A. Stradling. Thanks; you will see that we have already used a letter on the subject of the lizard's name.—E. R. Cowley. Neither of the works you name is now a trustworthy guide. In my book on the sun, the motions of the earth and sun are dealt with rather fully. —W. H. Collins. Many thanks; but articles of the same kind have already appeared.—H. A. Bulley. You mistake; Sir W. Thomson is fully aware of the nature of lunar influence, as understood by selenometeorologists. His way of expressing himself was simply a sort of abridged notation for a more complete rejection.—J. A. Ollard. 1. Do you mean that you can actually detect any incorrectness in the wings as depicted by that method? 2. Have you done so large a share of head-work that you can form an opinion on the particular question touched upon by my "learned friend?" I have myself tried the non-alcoholic drinks, and I consider their value for the purpose indicated to be *nil*. But then my experience may be quite exceptional. 3. Fairy rings are now nearly exhausted.—T. D. W. M. Mr. Proctor does not get under the influence of his poison until after his work is done. But I have asked him your question; and he begs me to say that the moon's attraction and the moon's influence in raising tides are very different things. The latter in part depends on the relative distance of the nearest and farthest parts of the earth, and the earth's centre from the moon. This introduces an element which increases the effect of proximity. I expect to persuade Mr. Proctor, in one of his cheerful moments, to write a short article on the tides.—M. B. A. I find it very difficult to answer your questions. You seem so much more certain about everything than I feel about anything. I cannot but think you are wrong about "the nasty oxygen." Surely oxygen cannot be altogether nasty and destructive.—W. Hicks. The idea that nothing can be destroyed—that "when the brains are out the man is" yet not "dead," but his thoughts go about in the ether, affecting men in some way we cannot understand—is pleasant, but it can hardly be said to represent as yet any established truth. I do not know of any trustworthy authority about thought-reading.—Sufferer desires to hear of some remedy for stammering.—A Perplexed Student. The reviewer is, to put it mildly, mistaken. If 0+2 is not equal to 0, by what does it differ from 0? I suggested, in answer to another correspondent that that reviewer should be rewarded by the sum of £1,000,000 multiplied by 0+2. I would now suggest a different reward for him. Let him receive the sum of £10,000,000, multiplied by the difference between 0 and 0+2.—Yalc. Yreh Ruthra. Yes, there is a way of making up one hundred out of the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9. Try again.

ELECTRICAL.

H. Williams. The platinum wire passing through the glass of an incandescent lamp, to which the filament is attached, does not become incandescent, because it is comparatively thick, and does not therefore offer the necessary amount of resistance. The best way to regulate the intensity of a current is to regulate the speed at which the dynamo is driven. Where there is a large installation, it is usual to have a lamp or two in the engine-room, which, by the light emitted, form a kind of gauge.—A. H. Keeling. A Daniell cell is easily made. Get an earthenware jar of about quart capacity, costing 6d. to 9d., a porous pot sufficiently high to stand half to three-quarters of an inch above the level of the jar. For the plates get a piece of thin sheet-copper (say about 6 inches by 4 or 5 inches), the thinner the better, for cheapness. Bend it into a cylindrical form to go inside the porous pot. Get also a sheet of zinc one-eighth of an inch thick, and about 6 inches by 9 or 10 inches, and bend it into a cylinder to stand inside the earthenware jar, and outside the porous pot. The zinc should be amalgamated (see answer to J. N. Frazer, Knowledge, No. 43). To charge the cell put crystals of sulphate of copper (in buying it ask for *electrical*) into the porous pot, so as to half fill it, then fill up with water. Fill the outer portion up with water acidulated with about one-twentieth its volume of sulphuric acid. Then get a couple of binding screws or terminals, one for the zinc, the other for the copper. If you can use a soldering iron you may save the shilling or so for terminals by attaching pieces of copper wire direct on to the plates. The metal plates, although directed to be six inches high, should stand half-an-inch or so above the porous pot and earthenware jar respectively.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. X.

By Richard A. Proctor.

We will consider a few more applications of the differential calculus to problems of maxima and minima.

A B, Fig. 1, is the section of a plane horizontal surface; L, a light vertically above A. If A B = 1 ft., at what height should L be, that the illumination at the point B may be as great as possible?

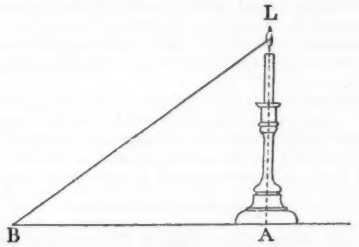


Fig. 1.

[It is clear there is a maximum here; for, if L is in the same level as B, the illumination is zero, and so also the illumination is zero if L is at an infinite height.]

Let A L = x. (The light is supposed to be a point, or, at any rate, to act as if collected at a point.)

Then $B L = \sqrt{A B^2 + A L^2}$

$= \sqrt{1 + x^2}$

And, according to the known laws of illumination, the illumination

at B varies inversely as the square of the distance B L, and directly as the sine of the angle L B A. Hence, taking m (which will not eventually trouble us) as a suitable constant, we may represent the illumination at B by the expression

$$\frac{m}{(BL)^2}\cdot\frac{AL}{BL}=\frac{m\,.\,AL}{BL^3}$$

Call this illumination y; then

$$y=\frac{mx}{(1+x^2)^{\frac{3}{2}}} \qquad \text{(i.)}$$

Now, to differentiate this expression, we take first the differential coefficient of the numerator and multiply it into the denominator. This gives

$$m\,(1+x^2)^{\frac{3}{2}}$$

Then we take negatively the differential coefficient of the denominator and multiply it into the numerator. This gives

$$-\frac{3}{2}(1+x^2)^{\frac{1}{2}}\,.\,2x\times mx, \text{ or } 3\,(1+x^2)^{\frac{1}{2}}\,mx^2$$

We have only to put the square of the denominator under these two expressions, thus

$$\frac{m\,(1+x^2)^{\frac{3}{2}}-3\,(1+x^2)^{\frac{1}{2}}\,mx^2}{(1+x^2)^3}$$

to get the differential coefficient of y, and we could reduce and simplify this expression considerably. But observe, we only want to equate the coefficient to zero (that being, as in former cases, the way of getting the required value of x). So that we have no occasion to write out the differential coefficient as above, or to reduce it. We need only write its *numerator* and equate *that* to zero. This gives

$$m\,(1+x^2)^{\frac{3}{2}}-3\,(1+x^2)^{\frac{1}{2}}\,mx^2=0 \qquad \text{(iii.)}$$

or, $(1+x^2)=3x^2$ [dividing out by $m\,(1+x^2)^{\frac{1}{2}}$]

That is $2x^2=1$

$$x=\frac{1}{\sqrt{2}}$$

Hence A L should be about $8\frac{3}{4}$ in.

If we had taken A B $=a$ instead of 1, we should have obtained the result:— $a^2+x^2=3x^2$

i.e., $2x^2=a^2$

or, $$x=\frac{a}{\sqrt{2}}$$

Note that the writing of this problem would be very short in practice. In fact, after expressing y in terms of x, as at (i.), the student would write down equation (ii.) at once; and solve as above.

Observe, again, that we can vary our method of attacking these problems by varying the relation whose change is to give our maximum. For instance, suppose we attacked the above problem in this wise:—

Let the angle L B A, Fig. 2, be called x. Then we know that B L = B A sec x. And the illumination at B may be represented by

$$\frac{m}{BA^2\sec^2 x}\,.\,\sin x$$

Putting this equal to y, we have,

$$y=m\cos^2 x\,.\,\sin x.$$

Hence $$\frac{dy}{dx}=m\,[-2\,\cos x\sin^2 x+\cos^3 x\,\text{ccs}\,x]$$

[I leave the reader to see how this is obtained by applying the rules given in preceding papers, noting that a very moderate degree of practice will enable him to write down such a result at once.]

Equating this expression to zero, we have

$$\cos^2 x\cos x=2\cos x\sin^2 x.$$

Hence $$\frac{\sin^2 x}{\cos^2 x}=\frac{1}{2}$$

or, $$\tan x=\frac{1}{\sqrt{2}}$$

i.e., $$\frac{AL}{BA}=\frac{1}{\sqrt{2}}$$

Hence $$AL=\frac{BA}{\sqrt{2}}=\frac{1}{\sqrt{2}}\text{ as before}$$

Neither method has the advantage in this instance, but often a good deal depends on a proper choice of the method to be followed. For example, suppose B is a point on a desk (Fig. 2) sloped at an angle a to the horizon, and that we require the height A L which will give the maximum illumination in this case. Then the first method would be very inconvenient; but, on applying the second, the value of y is little altered. We only have to put, instead of the factor sin x (*i.e.*, sin L B A), the value sin $(x-a)$ [*i.e.*, sin L B M], giving $$y=m\cos^2 x\sin(x-a).$$

And this is differentiated quite as easily as the other expression, giving

$$\frac{1}{m}\cdot\frac{dy}{dx}=-2\cos x\sin x\sin(x-a)$$
$$+\text{ccs}^2 x\,\text{ccs}\,(x-a).$$

Equating this to zero, we have,

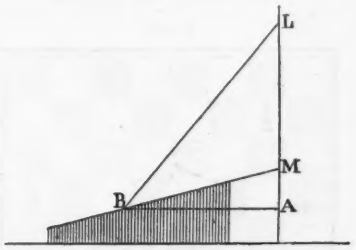


Fig. 2.

$$2\cos x\sin x\sin(x-a)=\cos^2 x\cos(x-a)$$

or, $$2\sin x\sin(x-a)=\cos x\cos(x-a). \qquad \text{(iii.)}$$

Here we want only a moderate familiarity with trigonometrical processes to get out our result, for equation (iii.) is the same as

$$2\cos a-2\,\text{ccs}\,(2x-a)=\cos a+\cos(2x-a),$$

that is $$3\cos(2x-a)=\cos a,$$

or, $$\cos(2x-a)=\frac{\cos a}{3}$$

This is sufficient for finding x, because a is supposed to be known. Suppose, for example, a is equal to eight degrees, *the slope of my desk*, for I have taken the notion of *working out this particular problem with the practical design of determining how high I should set the moderator which illuminates the paper I am writing upon*; we have then,

$$\cos(2x-8^\circ)=\tfrac{1}{3}\cos 8^\circ$$
$$=\tfrac{1}{3}\,(\cdot 99027) \text{ from a table of natural cosines}$$
$$=\cdot 33009$$
$$=\cos(70^\circ\,43')\text{ nearly enough}$$
$$\therefore\ 2x-8^\circ=70^\circ\,44'$$
$$2x=78^\circ\,44'$$
$$x=39^\circ\,22'$$

And A L, Fig. 2, is equal to B A tan x. Now, in the case of my desk and light, B A is equal to 18 in., and B, the part of the desk where I actually write (shifting the paper to this point as I write on line by line) is about 4 in. above level of table, so that the height of the light should be $(4+18\tan 39^\circ\,22')$ in.

I take out the log tan of $39^\circ\,22'$, which is $\bar{1}\cdot 91404$, and add to it the logarithm of 18, which is 1·25527, getting 1·16931, which is the logarithm of 14·768. Adding 4 to this, I find that the best height for the light of the moderator (above surface of table) is as nearly as possible $18\frac{3}{4}$ in.*

Russians employ petroleum successfully upon some of their railways for driving locomotives, using for this purpose the crude naphtha as it comes from the wells. Most of the steamers that ply the Caspian Sea use the liquid fuel, which is very much cheaper than coal. It is consumed with injectors such as are used in this country, and the combustion is regulated with the greatest ease.

---

* The reader well up in his "Gulliver" may be reminded here of the tailors of Laputa, who applied mathematical methods in taking their customers' measure, and were led sometimes by errors in calculation to make ill-fitting garments. An error in the working of the above problem might easily (for instance) have given 1·87in., or 187 in., instead of $18\frac{3}{4}$ in.; and the care necessary to secure a true result might well seem greater than the problem, practically viewed, is worth. I have indeed merely taken the problem as a convenient illustration of the fact that the differential calculus may often be applied to practical matters, without desiring to insist on the special value of the result obtained in this particular instance; though, be it noted, that as the light of my lamp stood but $16\frac{1}{4}$ in. high, I set the lamp $2\frac{1}{2}$ in. higher after I had worked out the above result.

XUM

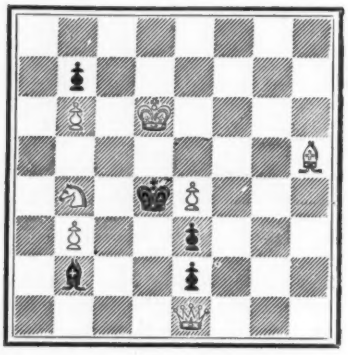
Our Chess Column.

By Mephisto.

PROBLEM No. 56.

By Alfred B. Palmer.

Black.



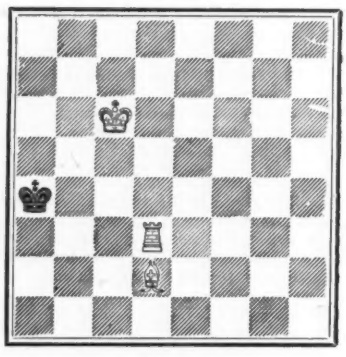
White.

White to play and mate in three moves.

PROBLEM No. 57.

By Leonard P. Rees.

Black.



White.

White to play and mate in three moves.

The following game was played at Manchester between Mr. A. A. Bowley and Mr. Kay-Leather :—

Two Knights' Defence.

White. A. A. B.	Black. K-L.	White. A. A. B.	Black. K-L.
1. P to K4	P to K4	16. Kt to B3	KR to K sq
2. Kt to KB3	Kt to QB3	17. Kt to K5 (*d*)	B takes Kt
3. B to B4	Kt to B3	18. P takes B	R takes P (*e*)
4. Kt to Kt5	P to Q4	19. B takes RP	QR to K sq
5. P takes P	Kt to QR4	20. K to R sq (*f*)	Q to B sq (*g*)
6. B to Kt5 (ch)	P to B3	21. B to KB4	KR to K2 (*h*)
7. P takes P	P takes P	22. B to Q3	P to Kt3 (*i*)
8. B to K2	P to KR3	23. B to KKt5	Kt to R4
9. Kt to KB3	P to K5	24. Q to B3 (*j*)	P to B3
10. Kt to K5	Q to B2	25. B takes KtP	P takes B
11. P to KB4	P tk P (en pas) (*a*)	26. B to B7 ch (*k*)	K to Kt2
12. Kt takes P	B to KKt5	27. Q takes Kt	R to K3
13. Castles	B to Q3	28. Q tks P (ch)	K to R sq
14. P to KR3	B to Q2 (*b*)	29. B tks R (K3)	B takes B
15. P to Q4	Castles (KR) (*c*)	30. R to B6	resigns (*l*)

NOTES.

(*a*) The moves so far are book moves. We should favour B to Q3 instead of taking the Pawn, as the Black Pawn is well posted on K5.

(*b*) As can be seen, Black has lost time by his eleventh and twelfth move, and White obtains a superior development.

(*c*) In this opening Black must attack, as otherwise the sacrifice of a Pawn would be useless. Instead of Castling, he might have ventured upon P to KKt4. Black has always the option of Castling QR for safety.

(*d*) White is now taking advantage of the position in an ingenious manner. He offers a bait which Black takes.

(*e*) This capture involves Black in difficulties; he ought to have retired his Knight to R2, and subsequently he might have made the advanced and isolated White Pawn the subject of his attack, for which purpose he ought to have brought his QKt over to his King's side.

(*f*) Necessary to enable White to play B to KB4, and deprive Black of the escape by Q to Kt3 (ch).

(*g*) Avoiding the threatened loss of the exchange, and also threatening B takes RP, which might be dangerous.

(*h*) It will be seen that besides losing his Rook's Pawn by his eighteenth move, Black's Rook is awkwardly placed, which is always the case when a Rook enters the game early.

(*i*) This move loses, but Black had hardly a good move.

(*j*) Acting coolly, White prevents Kt to Kt6 (ch) and Black cannot move his Rook from K2 on account of Q takes BP (ch).

(*k*) A powerful move, which speedily wins the game.

(*l*) It would have made no difference had Black played 29. R takes B, White would have won by 30. R to B7.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Problem No. 54 has proved a difficult one for our solvers, some of whom have failed to hit upon the pretty idea, in spite of repeated efforts. We believe there is some similarity between this problem and one published many years ago by Staunton, in the *Illustrated London News*; nevertheless, the idea is neatly worked out. We have received the most varied answers, thus: Y. Naylor gives 1. Q to Kt2; John O'Keeffe, 1. Q to B sq.; Kit, F. W. Cooper, Le Cavalier Noir, Novice, and several others, 1. Q to R5 (ch); R. Collins, 1. Q. to B5; G. A. Pearson and R. J. P., 1. Kt to Kt4 (ch), all of which are incorrect. We have received correct solutions from Squire, G. H. Bonner, Berrow. Problem No. 55.—To this pretty end position we have received several answers, all of which begin with 1. B to Q5 (ch). This, no doubt, is correct, and wins; but there is also another and prettier first move, which as yet none of our readers have found out.

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